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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/820,068	03/28/2001	Wei Pan	SLA 0493	4042

7590 12/19/2003
David C. Ripma, Patent Counsel
Sharp Laboratories of America, Inc.
5750 NW Pacific Rim Boulevard
Camas, WA 98607

EXAMINER

LUHRS, MICHAEL K

ART UNIT	PAPER NUMBER
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2824

DATE MAILED: 12/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/820,068

Applicant(s)

PAN ET AL.

Examiner

Michael K. Luhrs

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 October 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-12,21 and 22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2, 4-12,21,22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 March 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

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Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 2, 4, 5, 8, 9, and 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Danek et. al..

Regarding claim 1, a partially finished device is indicated in lines 37-38, column 4, includes a barrier metal layer 32a on substrate 30 (lines 33-34, column 3); is subjected to a non-plasma atmosphere (namely, Si_2H_6 , Si_3H_6 , $\text{SiH}_n\text{X}_{4-n}$ listed in line 7, column 4 are non-plasma) chosen from the group of, ambient vacuum, hydrogen gas, argon gas, or helium gas, to which Danek et. al. teach of ambient vacuum of 2 torr in lines 40-41, column 2; hydrogen gas is also contained in the non-plasma gases listed; subjecting the barrier layer to a temperature greater than 200 degrees C as in the thermal treatment, line 24, column 3, a processing temperature of 325 degrees is provided in line 61, column 3; copper is subsequently deposited, as indicated in the test example, line 37, column 4.

Regarding claim 2, Danek et. al. teach the temperature 325 in line 61, column 3 for in-situ thermal treatment, line 24, column 3, falls within the 250-550 degree range.

Regarding claim 4, Danek et. al. teach a pressure of 2 torr for the treatment of the barrier layer, in lines 39-41, column 3, falls within the 0.1 mtorr – 20 torr range.

Regarding claim 5, Danek et. al. teach subjecting the barrier layer to greater than 200 degrees for 30-100 seconds, namely 5-60 seconds at 325 degrees is as a post deposition thermal treatment in lines 51-52, column 3.

Regarding claim 8, Danek et. al. teach barrier metal layer chosen from the group consisting of TiN and TaN, since Danek et. al. teach TiN and TaN in line 33, column 3, and line 5, column 4.

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Regarding claim 9, Danek et. al. teach partial device including a barrier metal layer having a trench, as damascene trench in lines 49-50 column 2; subjecting barrier metal to greater than 200 degrees for at least 30 seconds, as the temperature of 325 in line 61, column 3, and 5-60 seconds, in lines 51-52, column 3; in a non-plasma atmosphere as non-plasma atmosphere of gases namely, Si_2H_6 , Si_3H_8 , $\text{SiH}_n\text{X}_{4-n}$ listed in line 7, column 4; chosen from the group of, ambient vacuum, hydrogen gas, argon gas, or helium gas, to which Danek et. al. teach of ambient vacuum of 2 torr in lines 40-41; wherein the barrier metal layer comprises TiN, as Danek et. al. teach TiN in line 33, column 3.

Regarding claim 10, Danek et. al. teach further comprising subjecting the barrier metal layer to a pressure in the range of 0.1 mtorr to 20 torr, since Danek et. al. teach a pressure of 2 torr for the treatment of the barrier layer, in lines 39-41, column 3, falls within the 0.1 mtorr – 20 torr range, and is simultaneous with the treated in non-plasma silane gas atmosphere of line 39, column 3.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 6 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Danek et. al. as applied to claims 1 and 9 above, and further in view of Wang et. al. USPN 6,184,128.

Regarding claims 9 and 11, Danek et. al. teach trench in lines 49-50 column 2, structural limitations, side wall, and bottom surface, are inherent to damascene trench, but Danek et. al. is absent of the structural limitation: trench width of 0.13. Wang et. al. teach a trench width of 0.13 in line 43, column 7. It would have been obvious to one having ordinary skill in the art at the time the invention was made of the knowledge of a 0.13 trench width as taught by Wang et. al.. Danek et. al. teach copper, but is absent of CVD specifically for the copper. Wang et. al. teach CVD in line 44, column 8. It would have been obvious

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to one having ordinary skill in the art at the time the invention was made of the knowledge of CVD to deposit copper in the trench.

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Danek et. al. as applied to claim 1, and further in view of Van et. al.

Danek et. al. teach improved adhesion, line 53 column 4, are silent regarding the tape test. Van et. al. teach that » Early attempts to measure adhesion included the use of the tape test. The tape method consisted of pressing a piece of adhesive tape to the film. The tape is then pulled off the film...this method is qualitative only, and if the film remains on the substrate, it provides no quantitative data as to the magnitude of the adhesion forces. Failure of the tape test implies that the film is unsuitable for device fabrication." Lines 6-14, column 2. It would have been obvious at the time the invention was made to one having ordinary skill in the art to include adhesion properties such that said copper film remains adhered to said pre-treated barrier metal layer in order to make the device suitable for device fabrication since failure of the tape test implies that the device would be unsuitable for fabrication.

6. Claims 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsai et. al.. Regarding claim 21, Tsai et. al. teach barrier in lines 57-58 column 4, temperature of 350-450 degrees and duration 5-180 seconds lines 20-21, column 4, and deposition of copper, lines 60-64, column 4. The cap layer can serve as the barrier layer see lines 53-55, column 6. It would have been obvious at the time the invention was made to one having ordinary skill in the art that since the cap layer can serve as the barrier layer the pre-treatment would serve the barrier layer.

Regarding claim 22, Tsai et. al. teach the chosen atmosphere is vacuum of 0.5 torr – 10 torr.

Response to Arguments

7. Itoh et. al. reference, is withdrawn, since the applicant's amended claim 9 in Amdt D adds the new limitation of non-plasma to which applicant asserts Itoh et. al. is absent of.

8. McTeer reference, the applicant argues that the hydrogen in line 55, column 17 applies to the copper layer. It is not definitively determined by the contents of the paragraph that surrounds line 55, whether McTeer meant the barrier layer and/or the copper layer, regarding the hydrogen.

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9. Tsai et. al. reference, applicant argues Tsai et. al. teach reactive nitrogen plasma in lines 22-23, p. 12 of applicant's Amendment D. First of all, claim 9, is absent of claiming non-plasma, and second, Tsai et. al. say nothing about their nitrogen treatment as being reactive.

Conclusion


10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

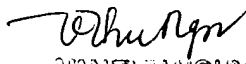
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael K. Luhrs whose telephone number is 703-305-2864. The examiner can normally be reached on M-F, 8-5.

12. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard T. Elms can be reached on 703-308-2816. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

13. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Michael K. Luhrs
December 4, 2003


VANTHUNGUYEN
PATENT EXAMINER